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THE NEED FOR COMPREHENSIVE ACTION TO ABATE OCEAN POLLUTION BY FLAME RETARDANTS

Erin Dooling[*]

I. INTRODUCTION

Flame retardants, used primarily in consumer products, such as furniture and electronics, have become pervasive in the marine environment within the last decade.[1] There are an estimated 175 types of flame retardants.[2] Many of them are polybrominated diphenyl ethers (PBDEs), which are easily absorbed by humans and marine species.[3] Harbor seals, an indicator species for the health of our oceans, reveal the

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1. *See generally* RENEE SHARP & SONYA LUNDER, IN THE DUST: TOXIC FIRE RETARDANTS IN AMERICAN HOMES, (2004), *available at* http://www.ewg.org/files/InTheDust_final.pdf [hereinafter IN THE DUST] (discussing a 1999 Swedish study that found PBDE levels increased in human breast milk by a factor of sixty between 1972 and 1997 and a U.S. study finding that flame retardant levels in breast milk are highest in American mothers); ENVTL. PROT. AGENCY, PUGET SOUND GEORGIA BASIN ECOSYSTEM INDICATOR REPORT: TOXICS IN HARBOR SEALS (2006) [hereinafter ENVTL. PROT. AGENCY I],*available at* http://www.epa.gov/pugetsound/pdf/indicators_report.pdf (finding polybrominated diphenyl ethers (PBDEs) in seals in Puget Sound, Washington); Kellyn Betts, *New Data Suggest PBDE Byproducts are Ubiquitous in U.S. Waters*, 43 ENVTL. SCI. & TECH., no. 14, 5161, 5161 (2009), *available at* http://www.usludgefree.org/pdf/hfw/hfw_pbde.pdf; *Pacific Seal Biomarker Study 1990-1998*, MARINE ENVTL. RES. INST., http://www.meriresearch.org/RESEARCH/PacificCoastSealProject/tabid/86/Default.aspx (last visited Oct. 7, 2010) (finding PBDEs in seals off the California coast); *Brominated Flame Retardants (PBDEs) in Northwest Atlantic Harbor Seals (2008)*, MARINE ENVTL. RES. INST., http://www.meriresearch.org/RESEARCH/BrominatedFlameRetardantsPBDEsinNorthwestA/tabid/172/Default.aspx (last visited Oct. 6, 2010) (finding PBDEs in seals in the Gulf of Maine).

2. Frank Carini, *How did Flame Retardants Become Such a Hot Chemical?*, R.I. ENVTL. NEWS (Apr. 20, 2010), http://www.ecori.org/pollution-contamination/.

3. This Comment will focus on PBDEs and will use the terms "PBDEs" and "flame retardants" interchangeably.

presence of PBDEs and other chemical toxins in their habitat.[4] Studying the effects chemicals have on seals can inform us about their potential effects on human health because seals and humans are both mammals, are at the top of the food web, and occupy coastal environments.[5] Seals also feed on many of the same fish humans consume.[6]

Some efforts to reduce PBDE levels in humans have been successful. After a ban of certain PBDEs in Sweden went into effect, researchers discovered that PBDE levels in human breast milk decreased.[7] The ocean, however, is a "global sink"—higher levels of PBDEs are observed in the ocean than on land.[8] Achieving such a reduction in the ocean thus requires a larger solution than simply banning industry use of PBDEs. Instead, reducing PBDE levels in seals and the ocean environment will require a comprehensive approach that impacts the entire range of PBDE usage—from creation to end-of-product-life management—and consists of actions by consumers, corporations, state legislatures, Congress, and foreign nations, including international treaties.

To understand why such a widespread approach is required, Part II will explore the nature of the problem by identifying the sources of flame retardants, how flame retardants reach the ocean, and the consequences of ocean contamination. This Comment will then evaluate existing and proposed regulations that affect the lifecycle of PBDEs, including restrictions on the sale and use of flame retardants in Part III, and

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4. Casco Bay Estuary Partnership, Toxic Pollution in Casco Bay: Sources and Impacts 61 (2007); Marine Envtl. Res. Inst., Seals as Sentinels: Assessing Toxic Contaminants in Northwestern Atlantic Coast Seals 6 (2006).

5. CASCO BAY ESTUARY PARTNERSHIP, *supra* note 4, at 61; *Pinniped Monitoring Program*, MARINE ENVTL. RES. INST., http://www.meriresearch.org/COASTALMONITORING/PinnipedMonitoringProgram/tabid/192/Default.aspx (last visited Oct. 6, 2010). Seals are marine mammals and obtain their food from the ocean, but they also haul out on land "to rest, give birth, molt, [and to] nurse pups," and thus are affected by changes in both the ocean and land. *Id.* We use these same aquatic environments for recreation, tourism, and employment.

6. Seals' major prey include silver hake, red and white hake, Atlantic herring, redfish, Atlantic cod, butterfish, and winter flounder. *Harbor Seal Prey Fish Consumption: Seasonal Patterns and Trends*, MARINE ENVTL. RES. INST., http://www.meriresearch.org/RESEARCH/HarborSealPreyFishConsumptionSeasonalPatter/tabid/176/Default.aspx (last visited Oct. 6, 2010).

7. *Fire Retardants in Toddlers and their Mothers: Gov't and Industry Action to Phase Out PBDEs*, ENVTL. WORKING GRP., http://www.ewg.org/reports/pbdesintoddlers/Governmentand%20IndustrytoPhaseOutPBDEs (last visited Mar. 25, 2012).

8. Susan D. Shaw & Kurunthachalam Kannan, *Polybrominated Diphenyl Ethers in Marine Ecosystems of the American Continents: Foresight from Current Knowledge*, 24 REV. ENVTL. HEALTH 157, 158 (2009), *available at* www.meriresearch.org/Portals/0/Documents/Shaw%20REH%2024(3)2009%20FINAL.pdf.

furniture disposal and electronic waste in Part IV. This Comment will conclude with suggestions for minimizing marine exposure to flame retardants.

II. THE NATURE OF THE PROBLEM

A. Sources of Flame Retardants

We encounter products containing flame retardants in our everyday lives. Flame retardants are added to numerous consumer products containing plastics, foams, and textiles.[9] They are primarily found in furniture, such as mattresses, upholstered furniture, and car seats,[10] and in electronics, such as televisions, cell phones, and computers.[11] They are also added to industrial products, such as lighting, wiring, building materials, and paint.[12]

Flame retardants have been on the market for more than thirty years.[13] North America accounts for half of all flame retardant usage worldwide.[14] Global production increased by nearly a 100 percent between 1992 and 2001,[15] and usage was projected to increase by 657 percent between 2001-2010.[16] Greater flammability requirements in

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9. Eighty-five percent of commercial plastics, foams, and textiles contain flame retardants. *Danger to Marine Life, Humans and the Environment—PBDEs are Everywhere*, SEA FOREVER (Oct. 25, 2010), http://www.sustainablewaters.com/danger-to-marine-life-humans-and-environment-%E2%80%93-pbdes-are-everywhere/; Bob Bohle, *The Effects of Ocean Pollution on Marine Mammals*, BLUEVOICE.ORG, http://www.bluevoice.org/news_issueseffects.php (last visited Nov. 13, 2010).

10. Other furniture products include mattress pads, vehicle seating, office furniture, and carpet padding. Dean Clark, *Reducing Your Exposure to PBDEs in Your Home*, ENVTL. WORKING GRP. (Oct. 7, 2008), http://www.ewg.org/pbdefree.

11. Other electronics products include remote controls, printers, toner cartridges, kitchen appliances, fans, hair dryers, and water heaters. *EWG's Guide to PBDEs*, ENVTL. WORKING GRP., http://www.ewg.org/pbdefree (last visited Nov. 12, 2010).

12. IN THE DUST, *supra* note 1, at 9.

13. *Toxic Flame Retardants (PBDEs): A Burning Problem in Our Bodies*, POLLUTION IN PEOPLE, http://pollutioninpeople.org/toxics/pbdes (last visited Nov. 12, 2010).

14. Sonya Lunder & Renee Sharp, Tainted Catch: Brominated Fire Retardants (PBDEs) Found in San Francisco Bay Fish—and People 10 (2003), http://www.ewg.org/files/PBDEs_final.pdf [hereinafter Tainted Catch].

15. *Id.* at 9.

16. In 2001, 449 million pounds of flame retardants were used. IN THE DUST, *supra* note 1, at 9. In 2010, consumption was projected to reach an estimated 3.4 billion pounds. *Albemarle's Earthwise Product Researcher Recently Presented on a New Generation Of Eco-Friendly Flame Retardants*, ALBEMARLE (June 15, 2010), http://ourgreenlab.com/2010/

consumer products are one of the primary reasons for industry growth.[17] At the same time, "highly flammable synthetic materials have replaced less combustible natural materials in consumer products."[18] Synthetic materials "produce hotter fires and more toxic smoke,"[19] and plastics, which contain oil, are accelerants.[20] "Ignition and rate of fire growth," however, are reduced by adding flame retardants to consumer products.[21] Annually, flame retardants save the lives of nearly three hundred people.[22] Still, a person today has an average of three minutes to escape from a burning home, compared with seventeen minutes in 1975.[23] Governments have responded to residential fire deaths by enacting fire codes and flammability requirements.[24] For example, in the 1980s, federal regulations required mattresses to be able to withstand smoldering cigarettes.[25] In 2007, California, a major market for PBDEs in the United States,[26] went a step further and required all mattresses to be able to withstand an open flame.[27] The federal government followed

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06/albemarle%E2%80%99s-earthwise-product-researcher-recently-presented-on-a-new-generation-of-eco-friendly-flame-retardants/.

17. *Flame Retardant Additives & Materials*, SOC'Y OF PLASTICS ENG'RS PLASTICS ENG'G, Feb. 2009 at 2, *available at* http://www.ticona.com/home/beta_homepage/green-electronics/greenelectronicspolyesterxfrplasticsengineeringart4.10.09.pdf.

18. TAINTED CATCH, *supra* note 14, at 9 .

19. *Flame Retardant Additives & Materials*, *supra* note 17, at 2.

20. There are approximately six liters of oil in plastics in a single TV set, for example. *Flame Retardants & Fire Safety*, BROMINE SCI. & ENVTL. FORUM, http://www.bsef.com/fire-safety-benefits/flame-retardants-fire-safety (last visited Jan. 12, 2011).

21. Envtl. Prot. Acency, *Pollution Prevention and Toxics: Polybrominated diphenylethers (PBDEs),* EPA.GOV, http://www.epa.gov/oppt/pbde/ (last updated Jan. 21, 2012) [hereinafter Envtl. Prot. Agency II]. Fires begin when free radicals break down molecules when heated, forcing carbon to interact with oxygen. Flame retardants remove free radicals. In addition, flame retardants delay "flashover," which is when a small fire suddenly becomes a much larger fire. WILLIAM P. KUCEWICZ, AM. COUNCIL ON SCI. & HEALTH, BROMINATED FLAME RETARDANTS: A BURNING ISSUE 2 (2006), *available at* http://www.acsh.org/docLib/20060809_flame.pdf.

22. Kucewicz, *supra* note 21, at 4; Janet Raloff, *New PCBs? Throughout Life, Our Bodies Accumulate Flame Retardants, and Scientists are Starting to Worry*, ENVTL. WORKING GRP. (Oct. 24, 2003), http://www.ewg.org/node/15790.

23. Flame Retardant Additives & Materials, supra note 17, at 2.

24. Kucewicz, *supra* note 21, at 3.

25. Bureau of Elec. & Appliance Repair, Home Furnishings and Thermal Insulation, Dep't of Consumer Aff., *Technical Bulletins*, CA.GOV, http://www.bhfti.ca.gov/industry/bulletin.shtml (last visited Nov. 18, 2010).

26. TAINTED CATCH, *supra* note 14, at 12.

27. Bureau of Elec. & Appliance Repair, Home Furnishings and Thermal Insulation, *supra* note 25; *Mattress Safety and Regulations FAQs*, UNDERWRITERS LABORATORIES,

California's lead and passed its own regulation requiring mattresses to withstand an open flame later that year.[28]

B. The Route to the Ocean

Consumer products containing PBDEs are a prime source of ocean pollution:

> PBDEs are a consumer product, or they're associated with consumer products. So the more people you have, the potential [for] more PBDEs you're going to have because you're going to have more couches, more TV sets, more carpets, and as a result, you have greater source[s] for PBDEs to move into the environment.[29]

One reason PBDEs move into the environment is because flame retardants are additives—substances that are mixed into plastic or foam[30]—and they are not chemically bound to the materials.[31] Consequently, flame retardants separate from the materials over time, ending up in air and dust.[32] Flame retardants "mix with house dust as foam furniture degrades or [as] electronic products emit chemicals through off-gassing."[33] Household dust has higher concentrations of flame retardants than food, water, air, and soil.[34] Dust and air containing flame retardants do not stay within our homes; rather, flame retardants that are dispersed into the air[35] ultimately flow into waterways.

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http://www.ul.com/global/eng/pages/corporate/newsroom/storyideas/mattresssafety/faq/ (last visited Jan. 12, 2011).

28. 16 C.F.R. pt. 1633 (2011); *Mattress Safety and Regulations FAQs*, *supra* note 27.

29. Nat'l Oceanic & Atmospheric Admin., *NOAA Report Calls Flame Retardants a Major Concern in U.S. Coastal Ecosystems*, NAT'L OCEAN SERV. 2 (2009), http://www.noaanews.noaa.gov/stories2009/images/pbdepodcast_transcript.pdf, [hereinafter *NOAA Report I*] (transcript from a portion of *Making Waves Episode 22: Flame Retardants Found in U.S. Coastal Ecosystems Nationwide*, NAT'L OCEAN SERV. (Apr. 1, 2009), oceanservice.noaa.gov/podcast/apr09/mw40109.mp3).

30. Up to fifteen percent of plastics and up to thirty percent of foam may consist of flame retardants. IN THE DUST, *supra* note 1, at 9.

31. TAINTED CATCH, *supra* note 14, at 9.

32. IN THE DUST, *supra* note 1, at 23-4.

33. *Id.* at 29. Off-gassing is when chemicals evaporate into the air out of the products to which they were added. *What is Offgassing?*, NATURENEUTRAL, http://www.natureneutral.com/learnOff.php (last visited Mar. 16, 2011).

34. IN THE DUST, *supra* note 1, at 6.

35. *See* Nat'l Oceanic & Atmospheric Admin., *NOAA Report Calls Flame Retardants Concern to U.S. Coastal Ecosystems*, NAT'L OCEANIC & ATMOSPHERIC ADMIN. (Apr. 1,

Showering and doing laundry[36] can cause flame retardants to mix with sewage, later applied as fertilizer in agriculture;[37] or they are directly discharged into water through storm water overflow systems.[38] Rain similarly washes outdoor dust containing flame retardants into wastewater overflow systems.[39]

Another reason flame retardants pollute the ocean is because furniture and electronic products containing flame retardants are eventually disposed of into landfills. These consumer products release chemicals into the air (as dust particles[40] or through incineration[41]) and the chemicals leach out of the products into water systems.[42] The pollution process is similar to other better known ocean pollutants, such as polychlorinated biphenyls (PCBs).[43]

C. Ocean Contamination

As the use of flame retardants has increased, so have the levels of flame retardants found in coastal waters. In 1996, flame retardants were found in only a few locations off the coast of the United States.[44] Today,

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2009), http://www.noaanews.noaa.gov/stories2009/20090401_ecosystems.html [hereinafter *NOAA Report II*].

36. Lisa Stiffler, *PBDEs: They Are Everywhere, They Accumulate and They Spread*, SEATTLE PI, Mar. 27, 2007, http://www.seattlepi.com/local/309169_pbde28.html.

37. Id. See NOAA Report II, supra note 35.

38. Kellyn S. Betts, *Deca PBDE Flame Retardant Gets Around*, ENVTL. WORKING GRP. (Jan. 8, 2004), http://www.ewg.org/node/15882; *NOAA Report II*, *supra* note 35

39. Betts, *supra* note 38.

40. Danger to Marine Life, Humans and the Environment—PBDEs Are Everywhere, supra note 9.

41. NOAA Report I, supra note 29.

42. Stiffler, *supra* note 36; *NOAA Report II*, *supra* note 35, at 2.

43. Shaw & Kannan, *supra* note 8, at 158. PCBs are chemicals that were largely used in electrical equipment. Much like flame retardants, PCBs began polluting the ocean because people dumped PCB-containing consumer products into landfills and PCBs were released through incineration or by leaching. Envtl. Prot. Agency, *Basic Information: Polychlorinated Biphenyl (PCB)*, EPA.GOV, http://www.epa.gov/osw/hazard/tsd/pcbs/pubs/about.htm (last updated Dec. 29, 2010). PCBs were banned in the 1970s. TAINTED CATCH, *supra* note 14, at 5; Patrick Shaw, et al., *Understanding the Sources and Fate of PCBs and PBDEs in the Georgia Basin*, ENV'T CAN., http://www.waterquality.ec.gc.ca/web/Environment~Canada/Water~Quality~Web/assets/PDFs/Acrobat%20DDocumen.pdf. PCBs were banned "with less data on health effects than [the U.S.] currently has on PBDEs." Tracy Daub, Note, *California—Rogue State or National Leader in Environmental Regulation?: An Analysis of California's Ban of Brominated Flame Retardants*, 14 S. CAL. INTERDISC. L.J. 345, 363 (2005).

44. NOAA ReportII, supra note 35.

flame retardants are "found in all United States coastal waters and the Great Lakes, with elevated levels near urban and industrial centers."[45] Pollution is not limited to coastal waters; flame retardants are now prevalent in ocean sediments,[46] and have been discovered in marine animals in remote locations.[47] Flame retardants are the first chemicals since DDT for which scientists have observed such a high rate of chemical buildup in human bodies and the environment.[48] Although DDT levels dropped off dramatically after it was banned,[49] scientists believe that PBDEs will "endure in the environment for decades," even if completely prohibited today.[50]

The three most common types of flame retardants are penta-bde, octa-bde, and deca-bde.[51] Penta-bde can be almost completely absorbed into the body, is bioaccumulative—toxins from food sources accumulate in species higher on the food chain—and can cause adverse health effects at low levels.[52] In contrast, octa-bde and deca-bde are not as easily absorbed by the body, are less bioaccumulative, and cause adverse health effects at higher concentrations.[53] However, deca-bde breaks down in the environment into more harmful forms of PBDEs when exposed to sunlight,[54] through biological and metabolic processes,[55] and in

45. *Id.*

46. See Kucewicz, *supra* note 21, at 13.

47. TAINTED CATCH, *supra* note 14, at 11; *NOAA Report II, supra* note 35.

48. Marla Cone, *Cause for Alarm Over Chemicals*, L.A. TIMES, Apr. 20, 2003, http://articles.latimes.com/2003/apr/20/local/me-chemicals20.

49. Shaw & Kannan, *supra* note 8, at 207.

50. Cone, *supra* note 48. Even today, over thirty years since PCBs were banned in the U.S., contamination and clean-up efforts are ongoing. *See* Kate Adams & Brian D. Israel, *Waste in the 21st Century: A Framework for Wiser Management*, 17 N.Y.U. ENVTL. L.J. 703, 707-8 (2008); *see also Dioxin-like Compounds in Harbor Seals from the Northwest Atlantic: Reassessing Toxic Threshold Levels*, MARINE ENVTL. RES. INST., http://www.meriresearch.org/RESEARCH/DioxinlikeCompoundsinHarborSealsfromtheNor/tabid/174/Default.aspx (last visited Feb. 28, 2012) (reporting that PCB levels in harbor seals have not decreased between 1991 and 2005, "suggesting a continuous input of PCBs in the northwestern Atlantic").

51. TAINTED CATCH, *supra* note 14, at 9.

52. *Id.* at 28.

53. *Id.* Some studies have not found health risks associated with deca-bde. Kucewicz, *supra* note 21, at 5.

54. TAINTED CATCH, *supra* note 14, at 28; IN THE DUST, *supra* note 1, at 14; BREAKDOWN (DEGRADATION) OF DECA-BDE, WASH. STATE DEP'T OF HEALTH 1 (2006), *available at* http://pollutioninpeople.org/files/doe_decabreakdown.pdf. When in wastewater, deca-bde can also release dioxins, which are highly toxic POPs. *Id.*; Betts, *supra* note 1, at 5161.

sediment,[56] directly exposing marine species at the bottom of the food chain to PBDEs.[57]

Several research studies on PBDEs have focused on seals in Maine, California, and Washington.[58] A study in the Gulf of Maine from 1991-2005 found that seals were exposed to the three major types of flame retardants (penta-bde, octa-bde, and deca-bde), but penta-bde exposure was the greatest.[59] This study was also the first to find deca-bde above trace levels in a marine mammal.[60] Another study found that harbor seals in Puget Sound, Washington, were twice as contaminated with PBDEs as those in British Columbia.[61] Between 1984 and 2003, flame retardant concentrations in Puget Sound harbor seals increased 1500 percent and were doubling every four years.[62] In California, PBDE levels in seals increased by a factor of one hundred in fewer than ten years.[63]

Exposure to flame retardants can cause a variety of health problems. Researchers in California found that seals exposed to flame retardants had higher white blood cell counts, indicative of poor immune response.[64] Studies conducted primarily on rats also discovered that flame retardants cause neurological and developmental damage, changes in metabolism,[65] behavioral effects, thyroid disruption, fetal malformations, cancer,[66] and reproductive defects.[67] In addition, lab

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55. IN THE DUST, supra note 1, at 32; BREAKDOWN (DEGRADATION) OF DECA-BDE, supra note 54; Brominated Flame Retardants (PBDEs) in Northwest Atlantic Harbor Seals (2008), supra note 1.

56. BREAKDOWN (DEGRADATION) OF DECA-BDE, supra note 52; Brominated Flame Retardants (PBDEs) in Northwest Atlantic Harbor Seals (2008), supra note 1.

57. Betts, *supra* note 1, at 5163.

58. These same three states have e-waste legislation that will be discussed Part IV.B, *infra*.

59. Brominated Flame Retardants (PBDEs) in Northwest Atlantic Harbor Seals (2008), supra note 1.

60. *Id.*

61. ENVTL. PROT. AGENCY I, *supra* note 1, at 130. Likewise, seal prey in Puget Sound were five times more contaminated than seal prey in British Columbia. *Id.* at 132.

62. *Id.* at 131, 138. In the recent National Oceanic and Atmospheric Administration study of mussels, Puget Sound had significantly high concentrations of PBDEs. *NOAA Report II*, *supra* note 35.

63. TAINTED CATCH, *supra* note 14, at 11. Studies of fish in San Francisco Bay showed that PBDE concentrations doubled approximately every two to three years. *Id.* at 18.

64. Jennifer Neale, *Contaminant-Induced Immune Alterations in the Pacific Harbor Seal, Phoca Vitulina Richardsi, of the Central Coast and San Francisco Estuary*, COASTAL ENVTL. QUALITY INITIATIVE (Dec. 1, 2003), http://escholarship.org/uc/item/1t41h8zj.

65. Betts, *supra* note 1, at 5161, 5163.

66. IN THE DUST, *supra* note 1, at 31; TAINTED CATCH, *supra* note 14, at 25.

animals' motor skills were ten times more affected when they were exposed to both PCBs and PBDEs than from each contaminant alone.[68]

The increased use of flame retardants, widespread ocean contamination, and the serious health effects they pose, makes a single solution insufficient. The problem requires a cooperative approach involving consumers, corporations, all of the states, the U.S. government, and the governments of other countries.

III. RESTRICTIONS ON USE AND SALE OF CERTAIN PBDES

A. Bans and Phase-Outs within the U.S.

States have led the way in banning PBDEs. California was the first to take action against the use of certain types of flame retardants.[69] By 2003,[70] the state had banned the manufacture and import of penta-bde[71] and octa-bde.[72] In deciding whether to ban penta-bde and octa-bde, the California legislature applied a precautionary principle method. The precautionary principle prioritizes health over economics: "when information about potential risks is incomplete [the method bases] decisions about the best ways to manage or reduce risks on a preference for avoiding unnecessary health risks instead of on unnecessary economic expenditures."[73] California's legislature determined that the potential for serious harm to human health and the environment from penta-bde and octa-bde was sufficient to create a ban on their use.[74] Several other states have also banned these chemicals, including Maine in 2005[75] and Washington in 2007.[76]

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67. Betts, *supra* note 1, at 5162.

68. TAINTED CATCH, *supra* note 14, at 9.

69. *Electronic Product Management*, CALRECYCLE, http://www.calrecycle.ca.gov/electronics/act2003/ (last visited Nov. 17, 2010).

70. *Id.*

71. Penta-bde is used in foam products, such as seat cushions and upholstered furniture. ENVTL. PROT. AGENCY I, *supra* note 1.

72. Octa-bde is used in fax machines, kitchen appliances, computer casings, automobile trim, and telephone handsets. *Id.*

73. Envtl. Prot. Agency, *Terms of Environment,* EPA.GOV, http://www.epa.gov/ocepa111/OCEPAterms/pterms.html (last visited Mar. 15, 2011).

74. Daub, *supra* note 43, at 354.

75. 38 M.R.S.A. § 1609 (2005).

76. 70 REV. CODE WASH. § 70.76.030 (2007).

Flame retardants are a $2 billion per year industry.[77] Predictably, the chemical industry fiercely opposed these state phase-outs.[78] The chemical industry contended that the California ban would require "'separate purchasing, supply channel, distribution, and transportation costs,' for which the consumer will ultimately assume responsibility."[79] The companies also argued that the bans would result in a decline in safety.[80] Despite industry concerns, Great Lakes Chemical, the only U.S. manufacturer of penta-bde and octa-bde, agreed to a voluntary phase-out of those two flame retardants from the national market by the end of 2004.[81] The European Union (EU) also instituted a phase-out for penta-bde and octa-bde by 2004.[82]

Deca-bde remains on the market, but some states are beginning to ban it from certain products.[83] In 2008, Maine banned the use of deca-bde in mattresses and upholstered furniture sold in the state.[84] Two years later, Maine prohibited the use of deca-bde in televisions and other plastic-encased electronics.[85] Washington also banned the use of deca-bde in mattresses in 2008, and since January 2011, the state has banned it from use in televisions, computers, and upholstered furniture.[86] Yet, despite California's precautionary principle approach with respect to penta-bde and octa-bde, the state determined that deca-bde does not pose a risk to humans or to the environment and has declined to ban it.[87]

At the federal level, the Environmental Protection Agency (EPA) released a project plan in 2006, setting goals for the agency to work with industries and governments regarding potential health risks from flame

77. Prasada Rao S. Kodavanti, *Brominated Flame Retardants: Health Effects*, EPA.GOV, http://yosemite.epa.gov/R10/ECOCOMM.NSF/Columbia/workshops/$FILE/Health_effects_of_Brominated_Flame_Retardants.pdf.

78. Daub, *supra* note 43, at 350.

79. *Id.*

80. *Id.*

81. Envtl. Prot. Agency II, *supra* note 21; IN THE DUST, *supra* note 1, at 37.

82. Jane Kay, *Study Finds Flame-Retardant Chemical in U.S. Breast Milk*, S.F. CHRON., Sept. 23, 2003, http://www.sfgate.com/cgi-bin/article.cgi?f=/c/a/2003/09/23/MN285358.DTL.

83. Deca-bde is primarily used in plastics found in wire and cable insulation, adhesives, and coatings. ENVTL. PROT. AGENCY I, *supra* note 1.

84. ME. REV. STAT. ANN. tit. 38, § 1609 (2010).

85. *Id.*

86. 70 REV. CODE WASH. § 70.76.030 (2011); ENVTL. PROT. AGENCY, POLYBROMINATED DIPHENYL ETHERS (PBDEs) ACTION PLAN 92 (2009), *available at* http://www.epa.gov/opptintr/ existingchemicals/pubs/pbdes_ap_2009_1230_final.pdf.

87. Kucewicz, *supra* note 21, at 11.

retardants.[88] The project plan had four objectives: (1) evaluate chemical substitutes for penta-bde and octa-bde, (2) assess the potential harm from deca-bde, (3) determine health and environmental risks from penta-bde and octa-bde, and (4) track developments from studies of PBDEs.[89] In December 2009, the EPA worked to obtain promises to phase out deca-bde from Albemarle Corporation and Chemtura, the two producers of deca-bde in the United States, and ICL Industrial, the largest importer of deca-bde to the United States.[90] The companies agreed to "end production, importation, and sales of deca-bde for most uses" by the end of 2012, and for all uses by the end of 2013.[91] The EPA promised to work with smaller importers of deca-bde to encourage them to stop importing the chemical.[92] The EU has similarly been phasing out deca-bde.[93]

B. New Flame Retardants

Bans of penta-bde, octa-bde, and deca-bde, however, do not prevent the use of other flame retardants that may be equally harmful. Chemical manufacturers can simply replace the banned flame retardants with others to avoid the ban. This happened when penta-bde and octa-bde were phased out in 2004.[94] Octa-bde was replaced by an existing flame retardant with a different chemical composition[95] and penta-bde was replaced by a new flame retardant already approved by the EPA.[96] These "chemical cousins" have also begun appearing in seals.[97] The Toxic Substances Control Act (TSCA) governs how new chemicals enter the

88. Envtl. Prot. Agency II, *supra* note 21.

89. ENVTL. PROT. AGENCY, POLYBROMINATED DIPHENYL ETHERS (PBDES) PROJECT PLAN 7 (2006), *available at* http://www.epa.gov/opptintr/pbde/pubs/proj-plan32906a.pdf.

90. Albemarle Corporation Commitment Letter, *available at* http://www.epa.gov/ opptintr/ existingchemicals/pubs/actionplans/deccadbe.html.

91. *Id.* "Most uses" includes electrical and electronic equipment and home furnishings, but excludes military and transportation uses, which will be eliminated by the end of 2013. *Id.*

92. *Id.*

93. Daub, *supra* note 43, at 349.

94. *Id.* at 351.

95. Mary Beth Polley, *Great Lakes to Phaseout Penta- and Octa PBDE Production by 2005*, PESTICIDE & TOXIC CHEM. NEWS, Nov. 10, 2003, at 20.

96. *Id.*

97. Sharon Kiley Mack, *More Man-made Contaminants Discovered in Maine's Harbor Seals*, BANGOR DAILY NEWS, Sept. 8, 2011, http://bangordailynews.com/2011/09/08/ news/downeast/more-man-made-contaminants-discovered-in-maine%E2%80%99s-harbor-seals/.

U.S. market,[98] and its approach differs greatly from the European program. In general, "U.S. law requires proof of risk before a chemical can be banned [whereas] European law requires proof of safety before a chemical can be used in the environment."[99]

1. The Toxic Substances Control Act

The TSCA was enacted in order to give the EPA "the authority to track industrial chemicals and to place restrictions on any that proved harmful to humans or the environment."[100] Every chemical already on the market before 1977, however, was exempted from testing requirements.[101] In fact, ninety-five percent of all chemicals have "never undergone any testing for toxicity or their impact on the environment."[102] Of the more than eighty thousand chemicals on the market, only two hundred have been tested.[103] Additionally, very little basic toxicity information is accessible to the public.[104]

The TSCA places the burden on the EPA to demonstrate that the chemicals create an "unreasonable risk of injury to health or the environment," and if it so finds, the agency must implement the least burdensome restrictions on the chemical industry.[105] The EPA simply does not have the resources to manage that high burden, and has banned only five chemicals.[106] Rather than replace banned flame retardants with "greener" flame retardants, U.S. chemical industries prefer to use existing chemicals or new chemicals that have undergone very little

98. 15 U.S.C. §§ 2601-2692 (2006).

99. Daub, *supra* note 43, at 368.

100. Mark Schapiro, *Toxic Inaction: Why Poisonous, Unregulated Chemicals End Up in Our Blood*, HARPER'S MAG., http://www.harpers.org/archive/2007/10/0081742 (last visited Nov. 18, 2010). *See* 15 U.S.C. § 2601.

101. 15 U.S.C. §§ 2602(9), 2607(b).

102. Schapiro, *supra* note 100.

103. *US Legislation Proposes Chemical Safety Reform in Consumer Products*, EARTHEASY BLOG (Nov. 5, 2010), http://www.eartheasy.com/blog/2010/11/us-legislation-proposes-chemical-safety-reform-in-consumer-products/.

104. David E. Adelman, *A Cautiously Pessimistic Appraisal of Trends in Toxic Regulation*, 32 WASH. U. J.L. & POL'Y 377, 385 (2010) ("[N]o basic toxicity information . . . is publicly available for 43% of the high volume chemicals manufactured in the US and a full set of basic toxicity information is available for only 7% of these chemicals.").

105. 15 U.S.C. § 2605(a). *See also* Corrosion Proof Fittings v. Envtl. Prot. Agency, 947 F.2d 1201, 1214 (5th Cir. 1991) ("[T]he agency bears a heavier burden when it seeks a partial or total ban of a substance than when it merely seeks to regulate that product.").

106. US Legislation Proposes Chemical Safety Reform in Consumer Products, supra note 103.

safety testing. Consequently, the TSCA "threatens innovation, particularly environmentally beneficial innovation such as new forms of 'green chemistry.'"[107]

Some companies have been innovative despite the temptations of the TSCA. Albemarle purports to have discovered a greener flame retardant: GreenArmor.[108] The company claims the molecules are too large to be absorbed by humans or animals and thus are neither bioaccumulative nor toxic.[109] The company also claims it is as effective as other flame retardants.[110]

Despite this recent development, chronic marine exposure to harmful flame retardants has continued almost unabated. Chemical companies support the current TSCA because it is viewed as "minimiz[ing] the likelihood of politically salient catastrophes occurring while allowing low-level chronic exposures to persist."[111] Continual accumulation, as observed with flame retardants, unlike a sudden, large-scale environmental disaster, does not rally consumers or politicians against the use of harmful chemicals.

In 2010, Congress proposed to amend the TSCA with the Safe Chemicals Act (SCA). The SCA would have shifted the burden away from the EPA, which currently must prove that a chemical is unsafe, to manufacturers, who would have to prove that a new chemical was safe.[112] To that end, manufacturers would have been required to submit basic data for each new chemical and the EPA would have had the authority to request additional data.[113] From that information, the SCA called for the creation of a public database.[114] The SCA would have also improved the EPA's ability to respond to harmful chemicals already on the market,[115] and would have established grants and other incentives for chemical manufacturers to develop safer chemical alternatives.[116]

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107. Adelman, *supra* note 104, at 438-39.

108. *Albemarle's Earthwise Product Researcher Recently Presented on a New Generation of Eco-friendly Flame Retardants*, *supra* note 16.

109. *Id.*

110. *Id.*

111. Adelman, *supra* note 104, at 428.

112. S. 3209, 111th Cong. § 6(b)(1)(B)(i) (2010).

113. *Id.* § 6(b)(2)(A)(i).

114. *Id.* § 8(d)(1).

115. *Manufacturers Must Test Chemical Safety in New TSCA Bills*, ENVTL. PROT. (Apr. 16, 2010), http://www.eponline.com/Articles/2010/04/16/Manufacturers-Must-Test-Chemical-Safety-in-New-TSCA-Bills.aspx.

116. *Id.*

The Safer Chemicals, Healthy Families Coalition criticized the SCA for not being progressive enough. They claimed that chemicals would be in use for several years before manufacturers would need to demonstrate their safety,[117] rather than requiring a demonstration of safety as a condition for entering the market. They also contended that the extent of the EPA's authority to halt production of the most dangerous chemicals was unclear.[118] Finally, critics were concerned that the SCA did not require the EPA to incorporate National Academy of Science recommendations as to "best and latest science" into their determinations.[119] On April 15, 2010, the bill was referred to the Committee on Environmental and Public Works and no further action occurred.[120]

Given all the reforms the TSCA needs in order to be effective at preventing flame retardants from polluting the ocean, as well as industry resistance to amending it, it is unlikely that any significant amendments will be made in the near future. In 2005, however, the EPA promulgated a Significant New Use Rule (SNUR),[121] requiring ninety-day notification prior to the manufacture or importation of penta-bde and octa-bde in the United States.[122] Although the SNUR complements the state initiatives banning the use of penta-bde and octa-bde, it is short of an outright ban on the chemicals. It also does not affect the manufacture or importation of deca-bde or other harmful flame retardants.

2. The Registration, Evaluation, and Authorization of Chemicals Program

The Registration, Evaluation, and Authorization of Chemicals (REACH) Program is the EU's chemical regulation program. Under REACH, unlike the TSCA, chemical companies have the burden of demonstrating the safety of their products. Specifically, REACH requires producers to demonstrate: (1) that the "benefits of a toxic compound outweigh its costs," and (2) "that a 'sound scientific basis'

117. Id.

118. *Id.*

119. *Id.*

120. *Bill Summary & Status 111th Congress (2009-2010) S. 3209 All Congressional Actions,* LIBRARY OF CONG. THOMAS, http://thomas.loc.gov/cgi-bin/bdquery/z?d111:SN03209:@@@X (last visited Nov. 18, 2012).

121. A SNUR is a "de facto ban." Kucewicz, *supra* note 21, at 6.

122. Pollution Prevention and Toxics: Polybrominated diphenylethers (PBDEs), supra note 21.

exists for restrictions on chemical sales and usage."[123] Further, the companies are required to make information about the chemicals publicly available.[124] REACH does not distinguish between new or pre-existing chemicals the way TSCA does;[125] instead, REACH employs a tiered system for assessing chemicals that varies "according to specified characteristics of a chemical and the manner in which it is used."[126]

Most chemical regulation schemes favor REACH's approach of placing the burden of proof on the producer and using a tiered structure.[127] The United States is "trailing these developments."[128] Meanwhile, commentators caution that "'precautionary' systems like those embodied in REACH represent more of a change in rhetoric than a fundamental shift in substance over the status quo."[129] REACH affects only twenty percent of the chemicals tested—the ones most likely to be sufficiently harmful to require regulation.[130] But even if REACH is not a remarkable departure from the *structure* of TSCA, it is a fundamental shift in *policy*: chemicals used in products have to undergo vigorous testing before use by consumers. Thus, if the United States adopted the tiered system of chemical review similar to that found in REACH, it would ensure that at least the most harmful substances would be vetted prior to their release in the market. This could prevent major environmental pollution, such as the build-up of PBDEs in the marine environment and in humans.

C. International Bans

Compared to the *ad hoc* banning of specific chemicals, a program that groups chemicals with similar properties, such as the tiered approach in REACH, would more effectively accomplish the safety goals of chemical regulation. For example, the international community banned persistent organic pollutants (POPs), which are a broad class of chemicals that share the common properties of persistence, bioaccumulation, the ability to travel long distances, and the possibility

123. Adelman, *supra* note 104, at 395.
124. *Id.* at 379.
125. John S. Applegate, *Synthesizing TSCA and REACH: Practical Principles for Chemical Regulation Reform*, 35 ECOLOGY L.Q. 721, 743 (2008).
126. Adelman, *supra* note 104, at 392.
127. *Id.* at 407-08.
128. *Id.* at 408.
129. *Id.* at 382.
130. *Id.* at 386.

of adverse effects.[131] The international approach to POPs may be instructive because like POPs, PBDEs are bioaccumulative, subject to long-range transport, likely to have adverse effects on human health and ecosystems, and are persistent—they do not degrade.[132]

Often used as pesticides, industrial chemicals, and byproducts, POPs negatively affect development, thyroid hormone levels, the immune and reproductive systems, and brain activity of seals,[133] much like flame retardants. The need for an international ban of POP chemicals is due to the widespread impact of POPs: the risks from POPs "[cannot] be confined to national boundaries, [and thus] the risks of continued manufacture and use [are] risks to all nations."[134]

The international community formally recognized the dangers of POPs on May 17, 2004, with the Stockholm Convention on Persistent Organic Pollutants (Convention).[135] The objective of the Convention is to "protect human health and the environment from persistent organic pollutants."[136] Over 150 signatories[137] to the Convention pledged to take measures to reduce the prevalence of twelve POPs, known as the "Dirty Dozen," in the environment.[138] Specifically, the Convention supports the transition to safer chemical alternatives, the cleanup of old stockpiles of

131. JACK WEINBERG, AN NGO GUIDE TO PERSISTENT ORGANIC POLLUTANTS 10 (2008), *available at* http://www.ipen.org/ipenweb/documents/ book/ngo_guide_pops.pdf.

132. *Id.*

133. *Id.*; CASCO BAY ESTUARY PARTNERSHIP, *supra* note 4.

134. Pep Fuller & Thomas O. McGarity, *Beyond the Dirty Dozen: The Bush Administration's Cautious Approach to Listing New Persistent Organic Pollutants and the Future of the Stockholm Convention*, 28 WM. & MARY ENVTL. L. & POL'Y REV. 1, 6 (2003).

135. Secretariat of the Stockholm Convention on Persistent Organic Pollutants, Ridding the World of POPs: A Guide to the Stockholm Convention on Persistent Organic Pollutants 4 (Apr. 2005), http://www.pops.int/documents/guidance/beg_guide.pdf.

136. Stockholm Convention on Persistent Organic Pollutants (Stockholm Convention) art. 1, May 17, 2004, *available at* http://chm.pops.int/Convention/tabid/54/language/en-US/Default.aspx.

137. Weinberg, *supra* note 131, at 16.

138. *Id.* at 17; Fuller & Thomas, *supra* note 134. Seven pesticides (aldrin, chlordane, dieldrin, endrin, heptachlor, mirex, and toxaphene) and two industrial chemicals (hexachlorobenzene (HCB) and PCBs) included in the "Dirty Dozen" are prohibited from all production and use by parties to the Convention, but parties are not prohibited from importing or exporting the chemicals. Stockholm Convention Annex A; art. 3 ¶ 1(a)(i); Annex A, Part I, note (i). DDT also makes the "Dirty Dozen" list, but can be used by parties for an acceptable purpose (such as control of malaria). Stockholm Convention Annex B, Part I. The last two chemicals to make the list are furans and dioxins, which are included in Annex C. These chemicals are unintentionally produced and the goal of the Convention is to minimize and ultimately eliminate the byproducts. Weinberg, *supra* note 131, at 21.

POPs, and provides for cooperation among nations for a "POPs-free future."[139]

The Convention also provides a method for adding new POPs to the ban. In this process, a party to the Convention submits a proposal to the Secretariat, who evaluates whether the chemical meets the screening criteria: persistence, bioaccumulation, long-range transport, and adverse effects.[140] If the Secretariat determines that the chemical meets these criteria, it will be submitted to the POPs Review Committee, which has the authority to require that the Party prepare a risk profile.[141] The POPs Review Committee uses a precautionary approach,[142] allowing a chemical to be added even without "full scientific certainty."[143] If the POPs Review Committee decides to list the chemical, an amendment will be made to the Convention.[144]

In May 2009, some brominated flame retardants, including penta-bde and octa-bde,[145] were added to the Convention.[146] The ban took effect beginning August 26, 2010.[147] This was the first time the Convention was amended to add new chemicals,[148] signaling that the ongoing review process is an important component of the Convention in fostering "the global effort to minimize [the impact of POPs] on human health and the environment."[149]

Now that some PBDEs have been added to the Convention, they will be subject to the requirements adopted by the Convention. Specifically, parties to the Convention will be required to clean up and properly dispose of stockpiles of PBDE wastes. The stockpiles must be "handled,

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139. Ridding the World of POPs: A Guide to the Stockholm Convention on Persistent Organic Pollutants, *supra* note 135, at 4.

140. Stockholm Convention Annex D; Weinberg, *supra* note 131, at 4.

141. Stockholm Convention art. 8, ¶ 6; Weinberg, *supra* note 131, at 24-25.

142. *See supra* Part III.A.

143. Stockholm Convention art. 8, ¶¶ 7 & 8; Weinberg, *supra* note 131, at 17.

144. Weinberg, *supra* note 131, at 28.

145. The amendment lists one of the four PBDEs as heptabromodiphenyl ether, which is commercially known as octa-bde. *Frequently Asked Questions on the Nine New POPs' Listing*, STOCKHOLM CONVENTION, http://chm.pops.int/Programmes/NewPOPs/FrequentlyAskedQuestions/tabid/762/language/en-US/Default.aspx (last visited Mar. 14, 2011).

146. The other flame retardant chemicals added were hexa-bde and tetra-bde. Press Release, Stockholm Convention on Persistent Organic Pollutants, Governments United to Step-Up Reduction on Global DDT Reliance and Add Nine New Chemicals Under International Treaty (May 8, 2009), *available at* http://chm.pops.int/Convention/Pressrelease/COP4Geneva9May2009/tabid/542/language/fr-CH/Default.aspx.

147. *Frequently Asked Questions on the Nine New POPs' Listing*, *supra* note 145.

148. Press Release, Stockholm Convention on Persistent Organic Pollutants, *supra* note 146.

149. *Id.*

collected, transported and stored in an environmentally sound manner."[150] Parties are encouraged to "undertake appropriate research, development, monitoring and cooperation," find alternatives,[151] and exchange information about reducing the prevalence of POPs.[152] In addition, parties must promote awareness and education about the impact of POPs on the environment and human health.[153] Finally, the Convention requires parties to prevent the production and use of new POP-like chemicals by taking those characteristics into account when conducting assessments,[154] thus attempting to stymie the substitution of one harmful chemical for another.

President Bush signed the Convention in May 2001.[155] However, despite several attempts to enact implementing legislation, the United States has yet to ratify the Convention.[156] Ratification requires the advice and consent of two-thirds of the Senate[157] and would require significant amendments to the TSCA, which has rarely been amended since it was enacted.[158] In addition, programs and infrastructure would have to be created to ensure that the stockpiles of furniture, electronics, and other products containing PBDEs are processed responsibly.

Aside from the logistical impediments, the major hurdle to ratification is the precautionary approach with regard to adding POPs. The Bush Administration was concerned that the precautionary approach was not as scientifically sound as a full cost-benefit analysis[159] because it did not "take sufficient account of countervailing factors, such as costs, in listing its decisions."[160]

Like POPs, PBDEs "come back to us in our food, in our water, and through our air, [thereby creating] 'a circle of pollution requiring a global

150. Weinberg, *supra* note 131, at 44.

151. Stockholm Convention art. 11, ¶ 1; Weinberg, *supra* note 131, at 28-30.

152. Stockholm Convention art. 10; Weinberg, *supra* note 131, at 28.

153. Stockholm Convention art. 10, ¶ 1(c); Weinberg, *supra* note 131, at 58.

154. Stockholm Convention art. 3, ¶ 3; Weinberg, *supra* note 131, at 28.

155. *Congress and the POPs Treaty*, US POPS WATCH, http://www.uspopswatch.org/index-test-uscongress.html (last visited Nov. 14, 2010).

156. *Stockholm Convention - Status of Ratifications as of 15/03/2011*, US POPS WATCH, http://chm.pops.int/Countries/StatusofRatifications/tabid/252/language/en-US/Default.aspx (last visited Mar. 14, 2011).

157. U.S. CONST. amend. II, § 2, cl. 2.

158. Fuller & McGarity, *supra* note 134, at 32.

159. *Id.* at 3-4.

160. *Id.* at 16.

solution.'"[161] An international response is crucial to combating the global problem of marine pollution.

IV. THROWAWAY CULTURE[162]

A. Disposal of Furniture and Textiles

Although penta-bde and octa-bde are no longer produced in the United States, millions of pounds of the chemicals are "stockpiled" in homes and offices, waiting to be discarded.[163] There is a dearth of restrictions on the disposal of furniture and textiles containing PBDEs. Those items can be discarded into landfills, where flame retardants leach into the soil and water or are released into the air as dust or through incineration. State bans on PBDEs do not impact the existing products waiting to be discarded. States and municipalities should investigate furniture and textile disposal options that include, for example, safe disassembly and recycling of the materials.

B. Disposal of Electronic Waste

Every American household is estimated to have twenty-four electronic devices.[164] Over three hundred million computers and one billion cell phones are produced each year,[165] making older products rapidly obsolete. Like furniture, old electronics are stockpiled in homes and offices.[166] Only eighteen percent of e-waste in 2007 was collected

161. *Persistent Organic Pollutants Implementation Act of 2002: Hearing on S. 2118 Before the S. Comm. On Env't & Pub. Works*, 107th Cong. (2002) (statement of Sen. James M. Jeffords, Chairman, S. Comm. on Env't & Pub. Works).

162. *Where Does All the E-waste Go?*, GREENPEACE INT'L, http://www.greenpeace.org/international/en/news/features/e-waste-toxic-not-in-our-backyard210208/ (last visited Jan. 14, 2011).

163. *Toxic Flame Retardants (PBDEs): A Burning Problem in Our Bodies*, *supra* note 13; ANN BLAKE, BROMINATED FLAME RETARDANTS IN CONSUMER PRODUCTS: ENVIRONMENTAL & PUBLIC HEALTH CONCERNS 4 (2004), *available at* http://www.ecy.wa.gov/programs/swfa/mrw/pdf/Presentations/Ann%20Blake%20Brominated%20Flame%20Retardants.pdf.

164. H.R. REP. No. 111-168, at 3 (2010).

165. *The E-waste Crisis Introduction*, E-STEWARDS, http://e-stewards.org/the-e-waste-crisis/ (last visited Nov. 14, 2010).

166. Toxic Flame Retardants (PBDEs): A Burning Problem in Our Bodies, supra note 13; Blake, supra note 163, at 5.

for recycling.[167] Electronics not recycled go to landfills or are exported,[168] enabling PBDEs to disperse into the air or leach into the groundwater.[169]

The federal government has largely been silent on e-waste;[170] therefore, states have initiated a "patchwork"[171] of end-of-product life regulations to responsibly dispose of electronics. As a result, manufacturers are struggling to "comply with the plethora of state programs, given the diversity of regulatory schemes, the sudden increase in states that regulate electronics recycling, and the rising number of electronics nearing the end of their life-cycle."[172] There are two general types of e-waste legislation in this patchwork: advanced recovery (or consumer fee legislation) and producer responsibility (or product stewardship legislation). As of this writing, twenty-five states have implemented e-waste legislation.[173] California is the only state that has taken a consumer fee approach,[174] meaning consumers pay a fee at the time they purchase electronic products.[175] The other twenty-four states, such as Maine and Washington, use a producer responsibility system,[176] meaning that manufacturers of electronic products pay the cost of recycling them.[177]

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167. *Wastes – Resource Conservation – Common Wastes & Materials – eCycling Frequent Questions*, ENVIRONMENTAL PROTECTION AGENCY, http://www.epa.gov/osw/conserve/materials/ecycling/faq.htm (last visited Jan. 14, 2011).

168. Exportation of e-waste will be discussed in Part IV.C, *infra*.

169. Flame retardants are not the only harmful materials in e-waste. E-waste also contains lead, chromium, mercury, cadmium, aluminum, copper, iron, and gold. Aaron Ezroj, *How the European Union's WEEE & RoHS Directives Can Help the United States Develop a Successful National E-Waste Strategy*, 28 VA. ENVTL. L.J. 45, 48 (2010).

170. Heather L. Drayton, Note, *Economics of Electronic Waste Disposal Regulations*, 36 HOFSTRA L. REV. 149, 168 (2007).

171. Valerie Eifert, Comment, Collaboration Before Legislation: The Current State of E-Waste Laws and a Guide to Developing Common Threats for the State Patchwork Quilt, 18 PENN ST. ENVTL. L. REV. 235, 239 (2010).

172. *Id.* at 235.

173. *State Legislation*, ELEC. TAKEBACK COAL., http://www.electronicstakeback.com/promote-good-laws/state-legislation/ (last visited Nov. 14, 2010).

174. *Id.*

175. *Id.*

176. *Id.*

177. *Id.*

1. California's Consumer Fee Approach

California's e-waste law,[178] passed in 2003, was the United State's first e-waste law.[179] The law requires individual and business consumers of electronic products to pay a six-to-ten dollar fee at purchase.[180] California uses that money to reimburse recycling and collecting companies,[181] but the money collected from consumers does not cover the cost of implementing the legislation, causing taxpayers to shoulder some of that burden.[182] The point-of-sale fee has created a disincentive for consumers to purchase their electronics within the state.[183] The consumer fee approach also fails to place stewardship pressure on manufacturers,[184] creating a disincentive for companies to consider their products' end-of-life impact.

2. Producer Responsibility

Producer responsibility follows the idea of product stewardship, where manufacturers internalize the costs associated with their product design decisions.[185] Producer responsibility forces the manufacturer to "be innovative and environmentally conscious when developing new products."[186]

a. State Recycling Programs

Maine and Washington are examples of states that have taken a producer responsibility approach to e-waste. Maine passed its electronic waste law in 2005.[187] In Maine, municipalities schedule collection events and consumers can bring limited types of electronics to the event to be recycled.[188] If a manufacturer fails to pay recycling costs,

178. CAL. PUB. RES. CODE § 42463 (2006).
179. Jeremy Knee, Guidance for the Awkward: Outgrowing the Adolescence of State Electronic Waste Laws, 33 ENVIRONS ENVTL. L. & POL'Y J. 157, 161 (2009).
180. Adams & Israel, *supra* note 50, at 715.
181. Electronic Product Management, *supra* note 69.
182. Eifert, *supra* note 171, at 240.
183. *See* Drayton, *supra* note 170, at 171.
184. Id.
185. *Id.* at 164.
186. Eifert, *supra* note 171, at 241.
187. ME. REV. STAT. ANN. tit. 38, § 1610 (West 2001).
188. *E-Waste*, ME. BUREAU OF REMEDIATION & WASTE MGMT., http://www.maine.gov/dep/rwm/ewaste/index.htm (last visited Nov. 17, 2010).

manufacturers and retailers are forbidden from selling the non-compliant manufacturer's products.[189] In contrast, under Washington's e-waste law,[190] manufacturers have an option to either participate in the state recycling program or create their own program.[191] Whichever they choose, manufacturers are responsible for the costs associated with collecting, transporting, and recycling the waste.[192]

Until recently, only households in Maine were qualified to participate.[193] On June 8, 2011, the Maine Legislature passed LD 981, which "allows Maine's schools, non-profits, and small businesses with 100 or fewer employees to recycle their old electronics at no disposal cost to them."[194] In Washington, e-waste is accepted not only from households, but also from small businesses, schools and school districts, small governments, special purpose districts, and charities.[195] Maine only accepts televisions, video game consoles, computer monitors, laptops, digital picture frames,[196] and cellular telephones for recycling.[197] Similarly, Washington only accepts computers, monitors, laptops, and televisions.[198] All twenty-three producer responsibility states limit the types of electronics they will accept for recycling and limit who can recycle the products.[199]

All states must decide how to balance their desire for comprehensive e-recycling programs with the economic costs of e-waste programs. Maine, however, is the only state considering discarding its e-waste statute, even though it has "resulted in a net increase in jobs" in the state,[200] and has saved Maine taxpayers money.[201] Governor Paul

189. ME. REV. STAT. ANN. tit. 38, § 1610(3).

190. 70 WASH. REV. CODE § 95N (2007).

191. Drayton, *supra* note 170, at 174; 70 WASH. REV. CODE § 95N.030(1).

192. *Brief Comparison of State Laws on Electronics Recycling*, ELEC. TAKEBACK COAL., http://www.electronicstakeback.com/wp-content/uploads/Compare_state_laws_chart.pdf (last updated Oct. 20, 2011).

193. Id.

194. *Maine's Free E-waste Recycling Law Expands to Include Schools, Small Businesses*, ELECTRONIC WASTE J. (June 13, 2011), http://www.ewastejournal.com/maine%E2%80%99s-free-e-waste-recycling-law-expands-to-include-schools-small-businesses/; *see also* Beth Quimby, *Maine May Dump E-waste Statute*, PORTLAND PRESS HERALD, Feb. 6, 2011, http://www.pressherald.com/news/maine-may-dump-e-waste-statute_2011-02-06.html.

195. *Welcome to E-Cycle Washington*, WASH. DEP'T OF ECOLOGY, http://www.ecy.wa.gov/programs/swfa/eproductrecycle/ (last visited Nov. 17, 2010).

196. Brief Comparison of State Laws on Electronics Recycling, supra note 192.

197. ME. REV. STAT. ANN. tit. 38, § 2143 (West 2001).

198. Welcome to E-Cycle Washington, supra note 195.

199. State Legislation, supra note 173.

200. Regulatory Fairness and Reform Public Hearing in Sanford, ME, Feb. 7, 2011 (statement of Travis Wagner) (on file with author).

LePage, however, believes the statute interferes with a "friendly business climate, job creation and an improved economy."[202] In reality, Maine's e-waste is "disassembled and recycled primarily in New England,"[203] unlike other states. For example, the recent amendment to Maine's e-waste law enabled a local recycling facility to add at least sixteen jobs and removed the fee for small businesses to recycle electronics.[204] Nova Scotia, which has a similar e-waste law to that of Maine, has also observed economic growth of "new industries and jobs to turn the wastes into new products."[205] LePage proposes to amend the e-waste law to "[ensure] that manufacturers do not have to pay to recycle their consumer products and that these standards do not exceed those set in federal law."[206] As there is currently no federal law on e-waste, such a standard would be no standard at all. For now, LePage has not taken any action to amend the state's e-waste law, but it remains on his agenda to include in future governor's bills.[207]

b. Proposed Federal Recycling Programs

The Electronic Device Recycling Research and Development Act, presented in the Senate in 2009, would have provided grants for a thorough study of e-waste issues.[208] Grants would have funded "research on innovative and practical approaches" to the human and environmental impacts of e-waste,[209] which could have provided a foundation for a federal take-back law addressing e-waste. Among these grants was funding to universities "to develop curricula for environmental design in

201. John Richardson, *Manufacturers Balk at Adding Recycling Items*, PORTLAND PRESS HERALD, Feb. 26, 2010, http://www.pressherald.com/archive/manufacturers-balk-at-adding-recycling-items-_2010-01-22.html (Maine's e-waste law has saved taxpayers "between $1.4 million and $3 million annually.").

202. Quimby, *supra* note 194; *Phase 1 of Governor's Regulatory Reform Proposals*, http://www.maine.gov/legis/opla/phase1gov.pdf (last visited March 2, 2012).

203. Regulatory Fairness and Reform Public Hearing in Sanford, ME, *supra* note 200.

204. *Maine's Free E-waste Recycling Law Expands to Include Schools, Small Businesses, supra* note 194.

205. Richardson, *supra* note 201.

206. Quimby, *supra* note 194; *Phase 1 of Governor's Regulatory Reform Proposals, supra* note 202.

207. Rebekah Metzlerrmetzler, *LePage Cuts List of Regulatory Reforms for State*, PORTLAND PRESS HERALD, Feb. 15, 2011, *available at* http://www.pressherald.com/news/lepage-cuts-list-of-regulatory-reforms-for-state_2011-02-15.html

208. H.R. REP. No. 111-168, *supra* note 164.

209. *Id.* at 1.

electronic devices,"[210] so that manufacturers could reduce the use of toxic materials, such as PBDEs, in electronics. The bill also would have called for the creation of a "database for environmentally preferable alternative materials, design features, and manufacturing practices,"[211] which could have provided manufacturer accountability to consumers and competitors. In addition, the EPA would have received more funding for research on the effects of e-waste on human health.[212] Funding would have also been available to study ways to increase consumer participation in responsible e-waste recycling practices.[213] Finally, the bill would have encouraged research into methods for limiting exportation[214] and "economic and domestic employment impacts associated with recycling and harvesting materials from unwanted electronic devices instead of disposing of such devices directly in landfills,"[215] thereby recognizing that U.S. workers could be a solution to the e-waste problem.

Much of the information sought by this bill is already available through state programs. States are often heralded as "laboratories" for "regulatory innovation" and best practices.[216] With regard to e-waste, existing state programs provide a solid foundation from which a federal e-waste take-back program could be created. In April 2010, the Electronic Device Recycling Research and Development Act was placed on the Senate Legislative Calendar under General Orders,[217] but no further action was taken.

Uniform end-of-product disposal regulations would benefit both manufacturers and consumers. Manufacturers could rely on one disposal plan and consumers could recycle products without too many restrictions. Although state legislation on e-waste is necessary while no federal bills are in effect, "[i]t is essential to have national uniformity when regulating migrating persistent compounds such as PBDEs because spillover from a nonregulating [sic] or non-banning state will likely affect other states"[218] and other countries.

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210. *Id.* at 2.
211. *Id.*
212. *Id.*
213. H.R. REP. No. 111-168, *supra* note 164, at 3.
214. Id.
215. *Id.* at 8.
216. Ezroj, *supra* note 169, at 51.
217. *Bill Summary & Status 111th Congress (2009-2010) H.R. 2396 All Congressional Actions*, LIBRARY OF CONG. THOMAS (Apr. 22, 2009), http://thomas.loc.gov/cgi-bin/bdquery/D?d112:2396:./list/bss/d112HR.lst:: (last visited March 12, 2012).
218. Daub, *supra* note 43, at 352.

c. Other Countries' E-waste Programs

In addition to state programs, the United States should take notice of other countries' programs in developing its own federal take-back program. In 2002, the EU enacted the Waste Electrical and Electronic Equipment (WEEE) Directive contemporaneously with the Restricting Certain Hazardous Substances (RoHS) Directive.[219] These two directives are intended to complement each other.[220] Together, they are the "most comprehensive e-waste strategy in the world."[221]

The WEEE program is the EU's e-waste take-back program. Like producer responsibility states in the United States, WEEE follows the "polluter pays principle,"[222] placing the financial burden on producers of electronic products.[223] The purpose of WEEE is to force companies to "internalize disposal costs" of their products and encourage them to create "more environmentally friendly products."[224] Citizens of each Member State of the EU are guaranteed at least four kilograms (almost nine pounds) of free e-waste recycling per household.[225] Many more products are accepted for recycling than in U.S. state e-waste programs; households in the EU can recycle large and small appliances, telecommunications equipment, consumer equipment, lighting equipment, electrical tools, medical devices, toys, and sports equipment.[226] Upon collection, the manufacturer is required to act in an ecologically-friendly manner, either through responsible disposal or by reusing the products.[227]

RoHS bans several hazardous chemicals from most of the same consumer products addressed in WEEE.[228] In 2010, PBDEs were reviewed to determine whether they should be banned,[229] but they were

219. Ezroj, *supra* note 169, at 60.
220. *See id.*
221. *Id.*
222. *Id.* at 65.
223. *Id.* at 61.
224. *Id.*
225. Council Directive 2002/96, art. 5, 2003 O.J. (L 37) 24, 28 (EC).
226. *Id.* Annex 1A, at 33.
227. Adams & Israel, *supra* note 50, at 714.
228. Council Directive 2002/96, art. 2, at 26.
229. *Flame Retardant Substitution Activities in Electrical and Electronic Equipment: RoHS, (EU Impact Assessment) and Stakeholder Positions*, FLAME RETARDANTS-ONLINE, http://www.flameretardants-online.com/web/en/news/index.htm?showid=272 (last visited Mar. 16, 2011).

not ultimately added to RoHS.[230] Instead, a procedure for adding chemicals to RoHS in the future was created. One of the new criteria is whether end-of-life waste disposal of products releases the hazardous chemicals.[231] PBDEs, which are released into the environment upon disposal of consumer products, could be a prime candidate for later addition to RoHS.

Other countries have similar programs. For example, Korea implemented an Extended Producer Responsibility System in 2003.[232] This program requires that companies create "recycling-friendly products" and establish recycling facilities.[233]

Producer responsibility e-waste programs recognize that manufacturers of electronic products are in the best position to redesign their products, control what chemicals are added to them, and to handle recycling so they can reuse the materials. "In essence, this shift is forcing a sustainability review by manufacturers,"[234] that could ultimately reduce the prevalence of PBDEs in the marine environment.

C. Exportation of E-waste

Deterring e-waste from entering U.S. landfills is just the beginning of a solution. The majority of recycling companies export seventy to eighty percent of collected e-waste[235] to foreign countries, where they are able to leach PBDEs into groundwater or disassemble products improperly, releasing PBDEs into the air. In 2005, for example, sixty-one percent of CRT monitors and televisions collected for recycling were exported.[236] States are limited in their efforts to prevent e-waste from being exported because they frequently offer e-waste collection and

230. *RoHS Review Fails to Restrict New Substances but Creates Opportunity for a Future Ban on Brominated Flame Retardants and PVC*, INT'L CHEMICAL SECRETARIAT, Nov. 24, 2010, http://www.chemsec.org/news/news-2010/650-rohs-review-fails-to-restrict-new-substances-but-creates-opportunity-for-a-future-ban-on-brominated-flame-retardants-and-pvc.

231. *Id.*

232. Adams & Israel, *supra* note 50, at 714.

233. *See* Il-Ho Park, *Policy Direction on E-Waste Recycling in Korea*, MINISTRY OF THE ENVT., 6, http://www.env.go.jp/recycle/3r/en/asia/02_03-4/07.pdf (last visited June 23, 2012).

234. Adams & Israel, *supra* note 50, at 714.

235. *The E-waste Crisis Introduction*, *supra* note 165.

236. Envtl. Prot. Agency, *Fact Sheet: Management of Electronic Waste in the United States*, ENVT. PROT. AGENCY, 1, 3, http://www.epa.gov/osw/conserve/materials/ecycling/docs/fact7-08.pdf (last visited June 23, 2012).

recycling contracts based upon the lowest bid.[237] As a result, recyclers are "able to externalize the real costs of doing things in an environmentally responsible way."[238] Countries receiving exported e-waste, the fastest growing waste stream, do not have the infrastructure to handle the influx.[239] The United States is not the only country that generates e-waste; it remains an issue for all developed nations. E-waste, like pollution by flame retardants generally, is a global problem.

1. Basel Convention

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, enacted in 1992, is the international community's response to the e-waste problem.[240] The Basel Convention's purpose is to prevent toxic waste, such as e-waste, from entering developing countries.[241] Specifically, the goals of the Basel Convention are to minimize hazardous waste generation, promote and use "cleaner technologies and production methods, [prevent] illegal traffic of hazardous waste, and improve institutional and technical capabilities . . . for developing countries."[242] The United States is the only developed country that has not ratified the Convention.[243] Without ratification, the United States is complicit in the exportation of e-waste to developing nations. However, federal legislation banning e-waste exportation or providing incentives to recyclers to safely disassemble products within the United States may bring the country closer in line with the goals of the Basel Convention.

2. Proposed Federal Legislation

In November 2009, Congress tried to lead by example by entertaining a resolution to create a recycling program for "obsolete computers and other electronic equipment used by offices of the

237. *Why Laws Aren't Enough*, E-STEWARDS.ORG, http://e-stewards.org/the-e-waste-crisis/why-arent-current-laws-enough/ (last visited Nov. 14, 2010).

238. NPR Staff, *After Dump, What Happens to Electronic Waste?*, NPR.ORG, Dec. 21, 2010, http://www.npr.org/2010/12/21/132204954/after-dump-what-happens-to-electronic-waste

239. *The E-Waste Crisis Introduction*, *supra* note 165.

240. *Basics of the Basel Convention*, BASEL.INT, http://www.basel.int/convention/basics.html (last visited Feb. 15, 2011).

241. Why Laws Aren't Enough, supra note 237.

242. Basics of the Basel Convention, supra note 240.

243. Why Laws Aren't Enough, supra note 237.

legislative branch."[244] The resolution would have required Congress to contract with recyclers that have been certified by E-Steward standards, which prohibit recyclers would from exporting the products they collect.[245] The same month it was proposed, the resolution was referred to the House Committee on House Administration,[246] but no further action occurred.

The Responsible Electronics Recycling Act, introduced in September 2010, would have "[made] it illegal [for U.S. recyclers] to send toxic e-waste to developing nations."[247] The proposed bill included a comprehensive list of electronic products.[248] That same month, the bill was referred to the House Committee on Energy and Commerce,[249] but no further action occurred. This bill alone, without simultaneously creating standards for U.S. recyclers or recycling facilities, might have overextended the current system.

Unless states continue to enact e-waste legislation and modify existing legislation to use reputable recyclers, the problem will continue. Federal legislation would cure the problem in one step.

V. PROPOSALS FOR REFORM

In crafting solutions to the multi-tiered problem presented by PBDEs, "national uniformity, accountability and authority to act internationally"[250] are paramount.

A. Chemical Bans and Safety

In the absence of future federal legislation banning PBDEs, states can and have banned certain harmful flame retardants. Statewide bans, especially California's, force manufacturers to alter their practices.

244. H.R. RES. 938, 111th Cong. (2009).

245. *Federal Legislation on E-waste*, ELEC. TAKEBACK COAL., http://etakeback.live2.radicaldesigns.org/promote-good-laws/federal-legislation (last visited Nov. 14, 2010); E-Steward standards are set by the Basel Action Network, which created an accredited certification program. *Id.*

246. *Bill Summary & Status 111th Congress (2009-2010) H. Res. 938 All Congressional Actions*, LIBRARY OF CONG. THOMAS, http://thomas.loc.gov/cgi-bin/bdquery/z?d111:HE00938:@@@X. (last visited Feb. 23, 2012).

247. Federal Legislation on E-waste, supra note 245.

248. H.R. 6252, 111th Cong. (2010).

249. *Bill Summary & Status 111th Congress (2009-2010) H. Res. 6252 All Congressional Actions*, LIBRARY OF CONG. THOMAS, http://thomas.loc.gov/cgi-bin/bdquery/z?d111:HR06252:@@@X. (last visited Feb. 23, 2012).

250. Daub, *supra* note 43, at 347.

These bans "[create] a domino effect, ultimately affecting the entire nation."[251] Although eventually the domino effect will create uniformity, federal regulations would accomplish consistency more efficiently because change would happen everywhere at once.

Banning certain flame retardants is just the beginning of the chemical regulation reform required to prevent flame retardants from reaching the ocean. What is really needed is an overhaul of the TSCA. As discussed in Part III.B.1, toxin regulation in the United States could be improved by adopting REACH's approach. In particular, the United States should implement REACH's tiered structure for evaluating chemicals, its public database of toxicity information, and its burden shift onto manufacturers. The tiered analysis would triage the chemicals, allowing the most harmful ones to receive the most rigorous review. PBDEs would no doubt fall into the tier receiving the greatest scrutiny because of their persistence, bioaccumulation, long-range transport, and adverse effects. In addition, shifting the burden for proving safety to manufacturers would empower the EPA to ban more harmful chemicals. Finally, forcing chemical producers to publicly disclose data relating to their chemicals would make them accountable to consumers and competitive with other producers, which could result in the development of more green chemicals. Implementing tax and similar incentives for developing and using "green chemistry" in plastics, textiles, and foams, should also be encouraged.

Additional future federal legislation should focus on ratifying the Stockholm Convention. As discussed in Part III.C, the greatest barrier to ratification is the resistance to using the precautionary principle for adding new chemicals. The precautionary principle is meant to recognize that in some instances harmful effects outweigh financial impacts, and to encourage companies to find ways to adapt. Ratifying the Convention would send a message that the United States will no longer tolerate dangerous flame retardants polluting our oceans.

B. Alternative Materials and Designs

Critics of efforts to ban certain flame retardants assert that human safety will be compromised in the event of fires. They also assert that more stringent regulations would be "expensive and can even risk product performance, which will ultimately hurt the company's bottom line."[252] The additional costs, however, are intended to force changes in

251. *Id.* at 357.

252. Ezroj, *supra* note 169, at 47-48.

current practices. Specifically, the costs should encourage changes in the base materials used to make furniture and electronics and also in product redesigns in order to reduce reliance on materials containing flame retardants.

Initially, efforts should be made—by manufacturers and consumers—to reduce reliance on synthetic fabrics and plastics. These materials are extremely flammable, greatly increase the temperature of fires, and release toxic substances when they burn, making fires more lethal to the home inhabitants and fire fighters.[253] Less flammable materials would require the use of fewer flame retardant chemicals to satisfy flammability requirements. In addition, non-synthetic materials and plastic alternatives leave a smaller impact on the environment.

In conjunction, companies should be encouraged to redesign certain products in order to reduce reliance on many of the materials containing flame retardants. This is what the Electronic Device Recycling Research and Development Act would have encouraged with its funding of university curricula and databases for environmentally preferable design and manufacturing processes. One way this might be accomplished is with a root cause analysis in order to illuminate the real source of the flammability problem.[254] For example, the root cause of TV fires might be lack of ventilation. This analysis could inform product redesigns, like adding fans, or efforts to ensure customers set up their entertainment units with enough air flow. With the redesign, manufacturers of TVs would not need to use plastics containing flame retardants.

Incentives for manufacturers should be provided to encourage alternative materials and designs.[255] Incentive programs could be in the form of tax deductions for creating more environmentally-friendly products, or in reducing the cost of participating in e-waste programs. Alternatively, companies could be mandated to create recycle-friendly products, as they are in Korea.

In addition, consumers in the United States are a powerful lobbying force for change: "Citizens of the U.S. are uniquely positioned to demand more from product manufacturers and from our federal government. We are the largest consumer market in the world and our federal government has expansive powers and bureaucracies to regulate environmental matters."[256] Industries harmed by the increased prevalence of PBDEs, in particular, should lobby for more stringent

253. Stiffler, *supra* note 36.
254. Blake, *supra* note 163, at 4.
255. *Id.*
256. *Id.* at 46.

regulations. People working in the fishing and tourism industries depend on healthy marine environments for their livelihoods. Also, more consumers are demanding eco-friendly products, and manufacturers could view this cultural movement as an opportunity to fill a new segment of the market. Additionally, an eco-certification program[257] could be created, signaling to consumers which products are environmentally friendly. Eco-certification programs could also spur competition among manufacturers to improve their products.

C. Responsible Disposal

1. Furniture

The lack of data and corresponding lack of regulations on furniture disposal is a gaping hole in the control of PBDEs. A study should be commissioned to evaluate the annual amount of furniture entering landfills, the materials furniture is made of, what chemicals are used, and how furniture can be recycled and reused safely. A federal act granting funding for such research could look similar in form to the proposed Electronic Device Recycling Research and Development Act. In addition, shifting to non-synthetic fabrics and renewable materials would assist the recycling process.

2. E-waste

As discussed in Part IV.B.2.a, state e-waste laws and any future federal take-back program should encompass as many products and disposers as possible. To that end, take-back programs should be more inclusive of the types of electronics accepted, as in WEEE, the sources electronics are accepted from (households, businesses, schools, governments, and other organizations), and recyclers should be "guarantee[d] free and convenient disposal,"[258] perhaps by implementing a per household or organization threshold as in Europe. Making the process easier for consumers would increase consumer participation.[259]

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257. The EU has an eco-labeling program that is separate from WEEE and RoHS. *The RoHS Review - Just a Small Step Towards Ban on Brominated Flame Retardants and PVC*, TCODEVELOPMENT.COM, http://www.tcodevelopment.com/pls/nvp/document.show?cid=4146&mid=731 (last visited Mar. 16, 2011).

258. Ezroj, *supra* note 169, at 67.

259. Knee, *supra* note 179, at 173-75.

The federal government ultimately needs to create uniform e-waste legislation so that manufacturers do not have to follow a patchwork of programs. Federal regulation would lower costs associated with e-waste for manufacturers because there would be consistency in standards—both nationally and internationally. Disposal programs would be the same across the United States and more similar to programs in Europe and Asia. There are various financing options for the federal program. For example, manufacturers could pay a fee based on the percentage of their national market share. Also, a small point-of-sale fee to consumers could minimize the need for unseen costs passed down to the consumers. Solutions that involve both manufacturers and consumers encourage individual and company responsibility. Finally, recycling contracts should only be awarded to recyclers who have obtained E-Steward certification, meaning recyclers who disassemble e-waste in the region and do not export it. To that end, Congress should also ratify the Basel Convention in order to eliminate exportation of e-waste to developing countries.

The federal government need not pass expensive bills like the Electronic Device Recycling Research and Development Act to gather research about effective e-waste programs. States and other countries have already been models of various programs. The sooner the government acts in instituting a take-back program and banning the exportation of e-waste, the sooner adverse environmental impacts from PBDEs can be minimized.

VI. CONCLUSION

The ultimate goal of these reform proposals is sustainability. "[S]ustainability asks not only how we should manage waste, but also how we can avoid or minimize the creation of waste."[260] This question should be asked not just of manufacturers in order to encourage stewardship, but also of the government in implementing policies and individual consumers so that they might take responsibility for their throwaway mentality and to choose safer products. Following PBDEs through their entire life cycle and enacting reforms at each stage is the only way flame retardant build-up in the marine environment can be prevented and abated.

260. Adams & Israel, *supra* note 50, at 705.